NRC INSPECTION MANUAL

INSPECTION PROCEDURE 72303

STARTUP TESTING FOR ABWR: TEST PROCEDURE REVIEW, TEST WITNESSING, AND TEST RESULTS EVALUATION

PROGRAM APPLICABILITY: 2504

72303-01 INSPECTION OBJECTIVES

01.01 Determine if the startup test procedures are consistent with the licensee's technical and administrative criteria, COL commitments, DCD, FSAR, regulatory requirements, and TS (See Section 05 in this IP for a list of acronyms).

01.02 Witness some ABWR startup tests, and determine if they are being performed in accordance with the COL, DCD, FSAR, and test procedures.

01.03 Assess whether test records are in accordance with licensee procedural controls, and accurately depict the startup test procedures as modified during their implementation.

01.04 Determine if the startup test results are being evaluated in a consistent manner so as to ensure that test acceptance criteria are met.

72303-02 INSPECTION REQUIREMENTS AND GUIDANCE

02.01 Review of Startup Test Procedures. Verify that a test procedure exists for each Class I and Class II startup test shown in Attachment 22. Select either Group A or Group B startup tests in Class I from Attachment 22. Then for the tests in the group selected, review the startup test procedures for the following and the additional requirements in the respective Attachments 1-21:

a. Management approval is indicated. All test procedures shall include licensee operations management review, regardless of who prepares the procedures.

b. Safety review committee approval is indicated. The FSAR and TS will identify those tests which require special committee review, and will define the committee composition.

c. Format is consistent with ANSI N18.7 and RG 1.68, Appendix C.

d. Test objectives are clearly stated along with all DCD and FSAR commitments.

e. Pertinent prerequisites are identified, for example

    1. Required plant systems are specified.
    2. Proper facility procedures are specified.
    3. Completion of calibration checks, limit switch setting protective device setting, included where applicable.
    4. Special supplies and test equipment are specified.

f. Special environmental conditions are identified.

g. Acceptance criteria are clearly identified. The test shall require a comparison of the test results with the acceptance criteria.

h. The sources of the acceptance criteria and critical steps in the test procedure are identified, for example, the DCD, FSAR, TS. Sources of acceptance criteria are only necessary for critical variables.

i. Initial test conditions are specified, for example:

   1. Valve lineups.
   2. Electrical power and control requirements.
   3. Temporary installations (instrumentation, electrical, and piping).
   4. Temperatures, pressures, flows.
   5. Water chemistry.
   6. Other.

j All references are listed, that is, FSAR, drawings, codes, and other requirements.

k. Step-by-step instructions are provided to ensure that test objectives are met. Use of plant operating procedures by reference is permissible provided the operating procedures have been approved for use as stated in the FSAR and TS.

l. All items, including prerequisites, can be initialed to indicate their completion. Sign-offs of individual steps should include the date and time, if the actual time is pertinent to the test. Initials and check marks or stamps may be used if they are traceable to an individual.

m. Provisions and instructions are provided for recording details of test performance, that is, deficiencies, their resolution, and retest.

n. Steps are provided to restore temporary connections, disconnections, or jumpers to their normal state or to control them.

o. Test personnel, conducting the testing and evaluating the test data, are identified in the test records.

p. Quality assurance verification is provided for critical steps or parameters. Modifications of the tests from how described in the FSAR, in any manner, shall require special review, evaluation, and approval pursuant to Appendix A, Section VIII of the ABWR Design Certification Rule, 10 CFR 52.63(b)(2), and 10 CFR 52.97(a)(2).

q. Each test procedure is consistent with the respective test description in the FSAR.

r. Special precautions for personnel and equipment safety are specified. Guidance is provided in RG 1.68, Appendix C, Section 1.c.

s. Instructions for testing a system or component over the full operating range/load change are provided. Guidance is provided in RG 1.68, Appendix A, Section 1.

t. Provisions are provided for the data taker to indicate the acceptability of the data. Guidance is provided in RG 1.68, Appendix C, Section 1.i.

u. Expected performance of automatic controls, for example, automatic actuation of process components and safety systems, is specified. Guidance is provided in RG 1.68, Appendix A, Section 1.

v. Provisions are made for using the plant simulator as a training means for startup testing and for updating simulator with data taken during the startup testing.

w. The tests shall meet the intent and operability requirements of the TS and their bases.

02.02 Witnessing Startup Tests. The inspector shall witness the Class I tests for the group selected in Section 02.01. Before witnessing a test, the inspector shall have completed a review of the test procedure per Section 02.01 of this IP. The inspector must be familiar with the test procedure in order to adequately witness the testing described in this IP. Communication must be maintained between the inspector and the licensee so that the licensee's test dates are known far enough in advance for the inspector to be ready to witness the selected tests. Licensees are not expected, nor are they to be asked, to delay conduct of a test pending the inspector's arrival.

a. Overall Crew Performance.

1. Current test procedure must be available and in use by all crew members. The inspector should determine the proper procedure revision by examining the licensee's master index or the "up-to-date" procedure file. Assure by examination and discussions that crew members are using the test procedure with the proper revision number and are familiar with the procedural requirements, especially the limitations and precautions.

2. Minimum crew requirements are met for both licensed and non-licensed operators.

3. Any test prerequisites and any initial conditions waived should be reviewed and approved in accordance with the test procedure or TS. Verify that procedural prerequisites and initial conditions have been met by reviewing the required records, for example, valve lineup list, instrumentation calibration procedure, system checklist, or signoff item in the listed test procedure or by direct observation, for example, monitoring instrumentation indications, valve positions, equipment start position switches, or personnel actions. Additionally, if the test involves the use of a TS Special Test Exception LCO, ensure that the LCO is adhered to and the applicable surveillance requirements are performed.

4. Test equipment must be calibrated and ready for use. Test equipment is normally required for measuring important parameters that determine the functionality of components and systems. Verify that the equipment is not outside its calibration period.

5. Crew actions are correct, timely, and coordinated. Crew coordination is an important part of any test since many of the steps involve coordinated activities between two or more crew members. The individual directing the test activities must have knowledge of the activities of each crew member and of the time sequence of activities when necessary. The test sequence may need to be interrupted or modified. These interruptions or changes must be communicated to crew members and any changes must be handled in accordance with existing procedures. On a sampling basis, verify adherence to the procedural limitations and precautions, and the individual test steps.

6. Summary analysis is made to assure proper plant response to the test. The acceptance criteria should be stated in the test procedure. Crew members should be knowledgeable of the expected events at their stations, that is,

control rod position, boron concentration, thermal power level, core axial and radial power distribution, DNBR, peak linear heat rates, system flow rates, pressures and temperatures. This type of information should be available to the person in charge in a timely manner so that an evaluation may be made soon after performing the test. Events or data individually within expectations may be collectively indicating unexpected results.

7. All data are collected for final analysis by the proper personnel. All necessary raw data must be gathered in a timely manner following the test. The person in charge must ensure that these data are collected, assembled, and transferred to person(s) performing the final analysis.

b. Test Results. The inspector should also, independent from the licensee evaluation, observe and evaluate certain events or data gathering during and following the tests. These events or data gathering activities should be selected during the inspector's review of the test procedure. The inspector should be knowledgeable of the expected measurements for important test parameters, for example, (1) the flow rate drops to 1/10 of the initial value for x seconds and returns to some other value within 2 minutes, (2) a specific reactivity change occurs during a specified time interval, or (3) computer printout values are read to be within the acceptance criteria. At least two of the most important events or data gathering activities shall be observed or evaluated by the inspector and the inspector shall verify the following:

1. That all test acceptance criteria have been met.
2. That licensee's preliminary test evaluation is consistent with inspector observation.
3. Adherence to the requirements of any TS LCOs affected during the test.

02.03 <u>Startup Test Program Review and Evaluation.</u> Performance of these activities will ensure the inspector is cognizant of test activities, test results, and test discrepancies or other plant problems affecting testing, including their disposition. These inspection requirements will normally be accomplished by the Resident Inspector. The inspector is concerned with potential problems that affect the implementation of the licensee’s Startup Test Program, most especially the Class I tests in Attachment 22.

a. Review the test sequencing document (or test procedure) including changes (daily).

b. Review the Startup Test Engineers Log (or equivalent), the Control Room Log, and the Shift Supervisor's Log, as applicable (daily).

c. Review Plant Information Reports or equivalent (daily).

d. Attend meetings of the Test Data Evaluation Group and the Plant Operations Review Committee or their equivalents (at least once every 2 weeks or at the frequency the meetings are held if less frequently than every 2 weeks).

02.04 <u>Evaluation of Test Results</u> . This IP provides a standard review practice to be applied to startup test results and applies to the Class I and II tests in Attachment 22. Following the licensee’s evaluation and acceptance of the test results, inspect the licensee's completed test data by doing the following:

For the group of Class I tests, selected in Section 02.01, and for 50% of the Class II tests for this design, complete all steps of this section below. For the remaining Class I tests and for the remaining 50% of the Class II tests, complete only steps e. and f. of this section.

For Class I tests that are in both Group A and Group B, do not duplicate steps e. and f. for them.

a. Review All Test Changes, Including Deletions. All changes, including deletions, to the test program should be reviewed for conformance to the requirements established in the FSAR and RG 1.68. If a change results in failure to satisfy FSAR commitments, or eliminates testing identified in RG 1.68, the change should have been reviewed and approved pursuant to 10 CFR 50.59.

   1. Verify that each change was approved in accordance with the pertinent administrative procedures and that the basis for the change is documented.

   2. Verify that the test procedure is annotated to identify test changes.

   3. Verify that the test change has been completed if it entails specific actions.

   4. Verify that nothing changed the basic objectives of the test.

b. Review All Test Deficiencies. In some cases, the test data will not be within the written predicted acceptance criteria. If this occurs, determine if further licensee actions will or have been taken. These actions may require (1) plant design changes, (2) evaluation by a manufacturer of the error between the design and predicted plant performance, or (3) restriction of plant operations because of the difference in plant performance and predicted acceptance criteria. The inspector must determine that for each of the above type actions, licensee followup corrective actions have been correctly performed, that is, 10 CFR 50.59 review, licensing approval if required, and subsequent testing for each design change, and do the following:

   1. Verify that each test deficiency has been resolved, that the resolution has been accepted by appropriate management, and that retest requirements have been completed.

   2. Verify that any system or process changes necessitated by a test deficiency have been properly documented and reviewed.

   3. Verify that deficiencies which constitute a reportable occurrence as defined by the TS have been properly reported (followup on reportable deficiencies is done by the inspectors).

c. Review ‘test exceptions’ which are inconsequential errors, for example, typo-like errors, in the test procedure which the licensee believes will not invalidate the test or create a test deficiency by doing the following:

   1. Verify that they were documented during the test.

   2. Verify that they were subsequently approved after the test is completed.

   3. Confirm that licensee has administrative and procedural controls in place to address such errors.

d. Review "As-run" Copy of Test Procedure. Make an independent technical analysis and use technical judgment to assure that the licensee's analysis has been performed correctly. Confirm that all test results have been compared with acceptance criteria and do the following:

1. Verify that data sheets have been completed (25% sample).

2. Verify that all data are recorded where required and are within acceptance tolerances (25% sample).

3. Verify that all test changes, deficiencies, and exceptions are noted.

4. Verify that individual test steps and data sheets have been properly initialed and dated.

e. Review the Test Summary and Evaluation. Review the test data packages assembled by licensees to ensure that the package is complete (as defined in licensee procedures). Ascertain that the licensee has verified that the acceptance criteria of the test procedure have been met. The inspector should use the appropriate means, for example, computer software, available for ensuring that test data supports the conclusion that test acceptance criteria have been met. The inspector should also do the following:

   1. Verify that the cognizant engineering function has evaluated the test results, and has signified that the testing demonstrated that the system or component met design requirements.

   2. Verify that the licensee specifically compared test results with established acceptance criteria.

   3. Verify that those personnel responsible for review and acceptance of test results have documented their review and acceptance of the data package and the evaluation.

   4. If the offsite review committee or equivalent has audited the test package, verify that the records reflect this audit and that their comments are included and corrective action has been taken.

   5. Verify the Quality Assurance/Safety Group or another independent organization's review of test results as prescribed in FSAR or other commitments.

f. Verify That the Test Results Have Been Approved. Verify that those personnel charged with responsibility for review and acceptance of test results have documented their review and acceptance of the data package and the evaluation.

   Normally, the test results are reviewed through the startup organization, culminating in review by a committee comprised of the Plant Superintendent, the NSSS Site Manager, the A/E Site Manager, or their designees. FSAR or other commitments frequently require review by Quality Assurance, Safety Review, or other independent organization.

   Frequently, test review committees will also have examined the results in accordance with TS requirements.

02.05 <u>Test Specific Inspection Requirements and Guidance</u>. Refer to the attachments for test specific inspection requirements and guidance that are based on the startup test program in Chapter 14 of the ABWR DCD. Some of these attachments have general guidance which is so labeled and located at the end of each of those attachments. Refer to Attachment 22 for the specific section in the ABWR DCD and for the appropriate reference to RG 1.68 for the respective test. The inspector should be fully aware that the test requirements in Chapter 14 of the DCD for a particular test are subject to change. The primary purpose of the inspection requirements and guidance in the attachments is to focus the attention of the inspectors and to provide insight into the specific aspects of each startup test. The inspection requirements are not binding requirements on any aspects of the licensee's startup tests for the ABWR advanced reactor design. The attachments are to be used for test procedure review, witnessing, and results evaluation.

72303-03 RESOURCE ESTIMATE

This IP supports review of the startup testing for this design. The resource estimate for this IP is approximately 350 hours of direct inspection effort.

72303-04 REFERENCES

ABWR Design Control Document, Chapter 14, "Initial Test Program"

RG 1.68, Revision 2, "Initial Test Programs for Water-Cooled Nuclear Power Plants"

72303-05 LIST OF ACRONYMS

ADS	Automatic Depressurization System
A/E	Architect Engineering
ABWR	Advanced Boiling Water Reactor
APR	Automatic Power Regulator
APRM	Average Power Range Monitors
ATIP	Automatic Traveling Incore Probe
CUW	Reactor Water Cleanup System
CRD	Control Rod Drive
CW	Circulating Water System
DCD	Design Control Document
DNBR	Departure from Nucleate Boiling Ratio
ECCS	Emergency Core Cooling Systems
EDGs	Emergency Diesel Generators
F/D	Filter-Demineralizer
FSAR	Final Safety Analysis Report
FW	Feedwater
FWCS	Feedwater Control System
HP	High Pressure
HPCF	High Pressure Core Flooder System
IP	Inspection Procedure
IST	Inservice Testing
ITAAC	Inspection, Tests, Analyses, and Acceptance Criteria
LOCA	Loss of Cooling Accident
LCO	Limiting Conditions for Operation
LP	Low Pressure
LPFL	Low Pressure Flooder Mode of RHR
LPRM	Local Power Range Monitors
MAPLHGR	Maximum Average Planar Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCR	Main Control Room
MLHGR	Maximum Linear Heat Generation Rate
MS	Main Steam
MSIV	Main Steam Isolation Valve
MSV	Mean Square Voltage
NOT	Normal Operating Temperature
NOP	Normal Operating Pressure

NBS	Nuclear Boiler System
NMS	Nuclear Monitoring System
NRHX	Non-regenerative Heat Exchanger
NSSS	Nuclear Steam System Supplier
OPRM	Oscillation Power Range Monitor
PGCS	Power Generation Control System
RCIC	Reactor Core Isolation Cooling System
RCIS	Rod Control and Information System
RCS	Reactor Control System
RCW	Reactor Building Cooling Water System
RG	Regulatory Guide
RHR	Residual Heat Removal System
RHX	Regenerative Heat Exchanger
RIPs	Reactor Internal Pumps
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RSS	Remote Shutdown System
RSW	Reactor Service Water System
Rx	Reactor
SLCS	Standby Liquid Control System
SRNM	Startup Range Nuclear Monitors
SRO	Senior Reactor Operator
SRV	Safety Relief Valve
S/D	Shutdown
S/U	Startup
TCW	Turbine Building Cooling Water System
TDH	Total Dynamic Head
T/G	Turbine Generator
TS	Technical Specifications
TSW	Turbine Service Water System

Attachments:

01. CRD System Performance
02. Core Performance
03. FWCS
04. FW Pump Trip
05. FW System Performance
06 Fuel Loading
07 Full Core Shutdown Margin Demonstration
08. Loss of T/G and Offsite Power
09. MS System Performance
10. MSIV Performance
11. NMS Performance
12. Plant Automation and Control
13. Plant Cooling/Service Water System(s) Performance
14. RCIC Performance
15. CUW Performance
16. RHR Performance
17. Shutdown From Outside the MCR
18. Steam and Power Conversion System Performance
19. Steam Separator/Dryer Performance Test
20. Turbine Trip and Load Rejection
21. Turbine Valve Performance
22. ABWR Startup Tests
23. Revision History For IP 72303

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. CRDs meet withdrawal speeds in system design specification and TS. The CRD speeds can be verified on readouts in the MCR.
2. Maximum scram insertion times of each CRD shall meet TS limits.
3. The CRDs shall have continuous motion during inserting and withdrawing.
4. For friction tests, the results shall agree with those taken during pre-operational testing.
5. For scram tests at cold conditions, the insertion times shall meet limits in TS. The licensee should define “cold conditions.”
6. For ganged movement of rods, the rods shall move together so that their positions with each other agree.
7. Rod decelerating devices should properly operate.

b. Assure these precautions are identified and met during the test:

1. Operation within power flow map acceptable range.
2. Safe shutdown margin maintained.
3. Reactivity changes only with specified approval.
4. No RPS trips.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing is complete. This should have included checks of operation of components for CRD’s hydraulic system including measures preventing the ejection of a rod above maximum speed.
2. Test equipment is available and calibrated.
3. Plant and Rx operating states specified.
4. RCS temperature and pressure maintained.
5. Control rod drive control system meets TS and Administrative requirements.
6. Rx protection circuits are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Periodic testing of CRDs . This is to ensure no binding during movement as the RCS approaches NOT and NOP as Rx power changes. Checks should be made of the integrity of the connections between hollow piston with ball nut and control rod for each CRD unit.
2. CRDs demonstrate proper movement based on signals from RCIS.
3. Scram tests for the following conditions.
   - -no flow cold
   - -full flow cold
   - -no flow, hot zero power
   - -full flow, hot zero power

   The rod insertion times should agree with TS for the stated test conditions. A CRT display provides indication of the positions of all control rods.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. MAPLHGR, MCPR, and MLHGR are in accordance with TS limits.
2. Core Rx power limited to rated core thermal power or in accordance with the power-flow map.

b. Assure these precautions are identified and met during the test:

1. The requirements of shutdown margin should not be violated.
2. Critical power ratio and heat generation rate should not be exceeded.
3. Startup rate limits not exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Plant power levels at which data will be taken and recorded.
2. RCS temperature and pressure.
3. Transient or steady state operations.
4. Required equipment to be functional per TS for plant conditions.
5. Instrumentation to take data for critical test parameters.
6. Related pre-operational testing is complete.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Obtaining test data and determination of core thermal power during plant heatup and power ascension for different rod positions and core flows.
2. Determination that heat flux limits are not exceeded.
3. Determination that local heat transfer limits are not exceeded. The licensee should define heat flux and local heat transfer limits and allowed tolerances.

General Guidance:

During testing of core performance, no protective trips should initiate and the core power and/or flow should not cause the plant to operate outside out of the acceptable range of the power flow map. The licensee's operators will base their conclusions on whether the thermal limits MAPLHGR, MCPR, and MLHGR have been exceeded primarily on current core thermal power. The licensee operators may use a display in the MCR or paper copy to compare the core thermal limits in the TS and the calculated values for those thermal limits at the different power levels. They will be able to readily discern whether any of the thermal limits have been exceeded. For review of low-power physics tests procedures, the following inspection procedures may be used for reference:

61702
61703
61704

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. The transient responses of FW flow into the vessel must be in accordance with system design specification.
2. The overshoot for the response of FW flow to any test input shall be per the system design specification.
3. For open loop testing, the transient responses of the FW actuators, controllers, and control valves to small step and large disturbances shall be per system design specification.
4. For closed loop testing, the transient responses of the master level controller to small and large step level disturbances shall be per system design specification for times and other parameters monitored.

b. Assure these precautions are identified and met during the test:

1. Critical power ratio and heat generation rate should not be exceeded.
2. The Rx does not enter restricted region of power and core flow plot.
3. Subcooling changes do not cause core instability.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing of FWCS.
2. RCS temperature and pressure.
3. FWCS is calibrated and at optimum functionality.
4. Rx power levels and status.
5. FWCS system engineer and I&C staff available.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Testing will be completed by manipulation of controllers or input of step changes during heatup and power ascension.
2. For open loop testing, checking the capability of FWCS to respond to small and large step inputs to verify its response and stability. The FWCS operates in single-element control mode for FW and steam flow rates below 25% and is then dependent on only Rx water level. For higher flow rates, the FWCS operates in the three-element control mode and is dependent on Rx water level, main steamline flow, main FW flow, and FW pump suction flow. All of these parameters have indication on the MCR panels.
3. For closed loop testing, evaluation and adjustment of master level controller settings for Rx water level set point changes for various operating modes of FW system. The Rx water level set point changes indicate core stability to subcooling changes.
4. Any uncertainties are stated and justified. The licensee should address the methodology for calculating uncertainties that will be incorporated into the data analysis. The test procedure should provide the justification to support that calculation methodology.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify that the procedure contains acceptance criteria for ensuring that the Rx should not scram for the loss of a FW pump if the initial Rx water level is halfway between high and low level alarm setpoints and that they are met.

b. Assure these precautions are identified and met during the test:

1. Rx should not trip due to water level transient.
2. The Rx does not enter restricted regions on power and core flow plot.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing of FW pumps and circuitry complete.
2. Equipment required to be operating and Rx status.
3. The FW pump control circuits and indication should be calibrated.
4. FWCS is available and calibrated.
5. Rx water level prior to test.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Initial Rx power level requiring more than 1 FW pump to be running.
2. Trip one of the operating FW pumps.
3. RIPs speed runback circuit should drop power level to where only 1or 2 FW pump(s) are required to be running. The inspector should denote whether the FWCS responds and what that response is, for example, the starting of a standby FW pump.

General Guidance:

The FW pumps take suction from the discharge of the four condensate pumps through four stages of low-pressure FW heaters. Three 33-65% capacity FW pumps operate in parallel and discharge to two parallel high-pressure FW heater strings that go into a common header. Two FW lines exit the common header and then near the Rx vessel split into three lines each that discharge into the Rx vessel. Each pump is driven by an adjustable speed drive. FWCS controls the flow of FW into the Rx vessel and it will send a Level 4 trip signal to the RFCS for a FW pump trip. Upon the receipt of the signal, the RFCS will determine the need for performing a recirculation runback to reduce the flow of the water through the Rx by reducing the speed of some or all the RIPs. The RFCS runback will aid in avoiding a low water level scram by reducing the Rx steaming rate and power level. During this time, there will a reduction in FW flow and an indication that a FW pump has tripped followed by a reduction in the flow of water through the Rx and a reduction in Rx power level and the megawatt output of the plant. Other indications will be a reduction in condensate flow and steam flow to the turbine.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Total FW flow for all FW pumps running with one pump at runout shall not exceed the values stated in Chapter 15 of the FSAR at the design pressure.
2. The change in flow below the design pressure specified shall not exceed tolerance in system design specification.
3. Runout capacity of a FW pump will exceed the value in Chapter 15 of FSAR.

b. Assure these precautions are identified and met during the test:

1. Rx should not trip due to water level transient.
2. The Rx does not enter restricted region on power and core flow plot.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing of FW pumps and circuitry complete.
2. Equipment required to be operating and Rx status.
3. The FW pump control circuits and indication should be calibrated.
4. Plant operating power levels during the test.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Verification that the following parameters for FW system, for all flows and plant operations, are in accordance with design especially those used in transient and safety analysis.
   a.) temperatures; pressures; flow rates; pressure drops; and pump speeds and pump heads.
   b.) FW pump runout; FW temperature vs power level; and FW flow versus Rx vessel pressure.
2. Check the calibration of FW system instruments.
3. Comparison of maximum FW flows with the FSAR followed by any necessary adjustments, and verification of adequate margins with setpoints for the parameters being monitored. System components should be able to operate over their design ranges of operation without any spurious actuations.

General Guidance:

FWCS monitors FW temperature and compares to a reference temperature. If that delta is exceeded, an alarm alerts the operator to a decrease in FW temperature and actions can be taken to mitigate the event. A signal is sent to the RCIS to run in some control rods to reduce Rx power to avoid a scram. A decrease in FW temperature should momentarily increase core power and vice versa for an increase in temperature. For the loss of one of the three FW controllers, there would be a possible runout of the associated FW pump but the FWCS would reduce the demand on the other operating FW pumps to offset the increased flow due to the one pump at runout. For the runout of all three pumps, the Rx could possibly scram due to high Rx water level. Rx pressure should decrease with a decrease in FW flow and vice versa for an increase in FW flow. The verification of the operation of this system could produce any of these results dependent on what malfunctions occur and what parameters are being tested.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Fuel assemblies installed consistent with designated configuration of Rx core. Fuel loading should be a slow, orderly process with sufficient licensee oversight.
2. Fuel loading steps documented for final core configuration. Licensee should have detailed record in case any changes are necessary.
3. Partially loaded core must be subcritical by at least the amount specified by the vendor with highest worth rod pair withdawn.

b. Assure these precautions are identified and met during the test:

1. Containment integrity established and maintained.
2. Controls for fuel loading established and maintained.
3. Initial fuel loading supervised by a SRO. Oversight by an SRO is required so that fuel loading proceeds in a controlled manner and so that any incidents are properly addressed.
4. Security measures and capability to monitor radiation levels addressed. NRC considers security of utmost importance and the licensee should take the necessary precautions.

c. Confirm these initial conditions are identified and met during the test:

1. Required Rx water level per TS.
2. Status of RCS water sources.
3. Conditions for loading fuel are met, and are being monitored and maintained.
4. Startup range neutron monitoring channels operable for monitoring core reactivity.
5. Pre-operational testing completed with open items addressed.
6. ITAAC are complete with any open items being addressed and approved by NRC.
7. Equipment required for fuel loading and status of secondary containment.
8. High flux scram and rod block trips set conservatively low.
9. Nuclear instrumentation calibration meets surveillance requirements.
10. Standby Liquid Control System is available and functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Loading of fuel assemblies one at a time per prescribed loading sequence. Loading must be conducted carefully exactly per established/approved sequence and detailed written procedures.
2. Changes in startup range indication are to be verified as expected or not. The goal is to maintain reactor subcritical during loading sequence.
3. Multiple checks of fuel assemblies of serial numbers and types. Attention to detail is needed to ensure fuel assemblies are in the correct location. Each fuel assembly should be in the exact position stated in procedure.
4. Criteria to be met to stop loading operations for a loading step in regard to count rate on startup range channels and decrease in boron concentration in accordance with NRC guidelines. Guidelines must be established to ensure unwanted criticality does not occur.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

   1. Rx achieved criticality as predicted within specified tolerances.
   2. The shutdown margin of the cold, fully loaded, xenon free core, with the highest worth rod pair withdrawn, meets TS requirements.

b. Assure these precautions are identified and met during the test: Signoffs for control. Nuclear instrumentation is calibrated per the TS. If more than 3 months after fuel loading, the SRNMs should be checked prior to initial criticality.

   1. A manual scram test is conducted not more than 24 hours prior to start of this test.
   2. Acceptable signal-to-noise ratios and the minimum acceptable count rate are specified for special startup and SRNM channels.
   3. A listing of RPS trips required to be in service, including reduced trip points if applicable.
   4. Shutdown margin is maintained.

c. Confirm these initial conditions are identified and met during the test:

   1. Nuclear instrumentation calibration meets surveillance requirements.
   2. RCS temperature and pressure requirements.
   3. Rod bank positions including when criticality occurs.
   4. Pre-operational testing is complete.
   5. Designated equipment required to be operable per TS.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

   1. Identification of control rod pattern prior to and during test. Rod bank positions should be specified for all rods, even part length rods. Controls should be identified.
   2. Requirements for maintaining Inverse Multiplication plots until criticality is achieved. Inverse multiplication plots are required if the licensee has committed to Regulatory Guide 1.68.
   3. Establishing an acceptable startup rate limit for increasing power following criticality. Startup rate limits are typically defined as a 60 second period but rates of 1 decade/minute are acceptable.
   4. Verification of overlap of SRNM and APRM range nuclear instrumentation. Since SRNM channels read from 10^{-8} to 15% power level only, an indication on the APRM channels would be required. This increase in power will occur during power ascension testing.
   5. Ascertain how control rods are to be withdrawn.
   6. The means for monitoring the approach to criticality and the plant operating procedures to be followed.
   7. State of Rx core.
   8. A verifiable method to obtain shutdown margin and the basis.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Primary and secondary systems stabilize.
2. The following systems operate as required without manual intervention:
   a.) RPS
   b.) EDGs
   c.) HPCF and RCIC if necessary
   d.) Turbine bypass valves
3. Proper instrument readings in the MCR.

b. Assure these precautions are identified and met during the test:

1. LPFL mode of RHR does not initiate.
2. ADS does not initiate.
3. MSIVs do not close.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level.
2. Primary and secondary safety valves operable.
3. RPS, EDGs, HPCF, and RCIC available
4. Turbine bypass system available.
5. Applicable instrumentation functional and available

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Low power level in power ascension.
2. Trip T/G and disconnect plant from offsite sources.
3. Monitoring of plant parameters for appropriate responses.

General Guidance:

Turbine trip initiates closure of main stop valves and turbine bypass operation. The closure of stop valves typically initiates reactor scram and trip of four RIPs but not for power levels less than 40%. The turbine bypass system will initially be placed into operation to handle the steam from the Rx. With the loss of turbine, the main generator is no longer supplying in-house loads and the emergency in-house loads will transition to the EDGs since offsite power is not available. The FW, condensate, and circulating water pumps will be lost with the loss of the generator and offsite power. Water level and pressure in the Rx vessel should decrease eventually with the RPS taking the necessary action to initiate the HPCF and RCIC systems without requiring the operation of the Low Pressure Flooder mode of RHR, ADS, or MSIV closure. At water level 4, there is a runback of the operating RIPs. At Rx water level 3, a Rx scram is initiated along with the tripping of four RIPs. At Rx water level 2, RCIC initiates and the remaining RIPs are tripped. At water level of 1.5, HPCF initiates but Low Pressure Core Flooder and ADS do not initiate until a Rx water level of 1. The pressure in the Rx should drop with HPCF and RCIC maintaining water level with all rods in and the EDGs running until the Rx is restarted and offsite power is restored. Indication of all these parameters will be evident in the MCR.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Main steamline pressure drops at selected points are per design.
2. Main-steamline flow venturi's differential pressure at rated flow per design.
3. Accuracy and noise level of output of main steamline flow venturi into FWCS shall meet design requirements.

b. Assure these precautions are identified and met during the test:

1. Integrity of main steamline is verified.
2. Vibration of main steamline is not excessive.

c. Confirm these initial conditions are identified and met during the test:

1. RCS temperature and pressure requirements.
2. Preoperational tests complete.
3. Plant configuration shall be that required by test.
4. Locations of field mounted instruments for measuring test parameters.
5. What equipment and the portions of systems that are being tested.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Critical system parameters shall be monitored.
2. Crosschecking of the output of steam flow measuring devices against that of FW flow measurements.
3. Evaluation for acceptance of the steamline pressure drops at selected points and using additional measuring points as required.

General Guidance:

This test is to measure main steamline pressure drop and steam flow. The pressure drop being measured is from the Rx vessel to the main steamline header to determine whether that pressure drop is within the design value. Pressure measurements will be readily available in the control room and on field-mounted instruments. The licensee should have pre-determined values of the expected steamline drops and should be able to determine whether the as-found values in the field are within the required tolerances. The pressure drop being measured may have to be divided into additional measurements for measuring purposes. Additional measurements are being made to determine if proper steam flow is being achieved and measured since steam flow is an input into the FW control system. The three inputs to the FWCS are steam flow, FW flow, and Rx water level. Without the proper steam flow Rx water level may be inaccurate and cause unnecessary alarms and initiations of ECCS systems. Steam flow will be determined at various points where there is some knowledge about what the expected values for steam flow should be. Crosschecking of steam flow will also be made for the input of steam flow for the leak detection system.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Proper operation and closure times of MSIVs and branch steamline isolation valves.
2. Rx will not scram or isolate for full closure of individual MSIV.
3. Rx pressure, neutron flux, fuel surface heat flux, and steam line flow have adequate scram avoidance margins for closure of an individual MSIV.

b. Assure these precautions are identified and met during the test:

1. MSIVs stroked prior to testing.
2. Operation within the power flow map.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing of MSIVs is complete.
2. Rx status and power levels for testing.
3. Required instrumentation installed and operable.
4. RPS trips associated with MSIVs and affected plant parameters are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Verification of MSIVs' operability and closure times at various plant power levels.
2. Assessment made as to maximum power level at which these tests can be performed.
3. Verification of branch steamline isolation valves functioning and stroke timing. This will be an opportune time to test the branch steamline isolation valves at rated temperature and pressure under the IST program.

General Guidance:

Protection logic allows one MSIV at a time to be closed manually for testing purposes. If one MSIV closes due to equipment or protection logic malfunction at a power level greater than 80%, then it is possible to get a high flux scram. The MSIVs close in 3 to 4.5 seconds with the worst case being 3 seconds at 100% power with that case analyzed in Chapter 15 of the FSAR. Typically the power level for this test procedure should be 80% or less. For this test, the power level will be such that thermal margins of fuel assemblies will not be even marginally decreased and the equipment should operate normally for the closure of each MSIV one at a time. The closure time of each MSIV should be within the tolerances stated in the test procedure. The MSIVs are opened and closed pneumatically with springs closing them if the pneumatic system is not working. A hydraulic dashpot controls the speed of closing with that adjusted by a valve in the hydraulic return line bypassing the dashpot. The test procedure should state the minimum allowed leakage of the MSIVs.

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Required count rates and signal to noise ratios for each SRNM.
2. Specified requirements for transfer from counting to MSV methods of measuring flux levels by SRNMs.
3. APRMs calibrated to read equal to or greater than core power and agree with heat balances.
4. Overlap requirements for SRNM and APRM channels.
5. LRPMs calibrated to read per test specifications. ATIP data and heat balances are used to provide calibration of LPRMs.
6. ATIP uncertainty requirements per test specification.

b. Assure these precautions are identified and met during the test:

1. Continuous monitoring by NMS as power level is increased.
2. Operation within the power flow map.
3. No more than allowable NMS detectors are bypassed.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing of NMS is complete.
2. Rx status and power levels for testing.
3. Required instrumentation installed and operable.
4. RPS trips associated with NMS are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Alignment and calibration of SRNM channels at overlap region between counting flux and MSV flux ranges.
2. Calibration of LPRM channels per test requirements.
3. During heatup SRNM and APRM channels shall initially be calibrated to read equal to or greater than core power during heatup.
4. Adjustment of LPRM and APRM channels per heat balance computation.
5. Proper alignment of ATIP uncertainty at mid and high power levels.

General Guidance:

The SRNM channels consists of 10 detectors in 4 channels designed to indicate neutron flux from 10^3 neutrons/cm^2 to 15% power. The transition from the counting to the MSV method for measuring neutron flux should be transparent. 3 conditions comprise the SRNM trip logic: SRNM upscale, rapid increase in neutron flux in a short period, and SRNM inoperative. There are 52 detector assemblies in the four channels of LPRMs with 4 detectors per assembly. 52 LPRM detectors provide signals to each channel of APRMs and there are four channels of APRMs. The LPRMs monitor local flux whereas the output of the APRMs is average neutron flux. A comparison can be made of the data for the heat balances and ATIP readings to verify the calibration settings of the LPRMs and the APRMs for various power levels. The LPRMs have alarms for certain conditions but they are not provided to the RPS. The APRM trip logic to the RPS is comprised of the following: high neutron flux, high simulated thermal power, APRM inoperative, OPRM trip, and Rx core flow rapid coastdown. The Rx will be at different power levels in order to calibrate the SRNMs, LPRMs, and APRMs.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. No single equipment failure shall disrupt plant operation.
2. No single equipment failure shall cause a setpoint change or change in system operating mode.

b. Assure these precautions are identified and met during the test:

1. Operation is with in the allowable region on power flow map.
2. Operator intercession should not be prevented in the semi-automatic and automatic modes of PGCS.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level and status.
2. Required pre-operational tests are completed.
3. Tests specifies required operable equipment per TS.
4. Setup of calibrated test equipment to record data.
5. SRO with support engineering personnel monitoring test.
6. Required RPS trips are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Plant operation for following modes using PGCS and APR:
   a.) Startup
   b.) Shutdown
   c.) Power Operation
2. Monitoring of required plant parameters to ensure safe operation of the plant within the power flow map.
3. Requirements for manual intercession if a problem should develop.

General Guidance:

The PGCS is a controller that monitors plant conditions, issues commands to non-safety related systems, and adjusts the setpoints of lower level controllers. The PGCS contains the algorithms for the automated control sequences associated with plant startup, shutdown, and normal power range operation. The operator interfaces with the PGCS to initiate an automated sequence from the operator control console then the PGCS takes over and implements that sequence. The actions by the operator will be visible but the only evidence of the PGCS performing will be the changes in plant parameters, i.e., reactor power associated with startup, shutdown, and power range operations. The PGCS interfaces with the APR which has the primary objective of controlling Rx power during startup, shutdown, and power range operations by issuing commands to change rod positions or changing recirculation flow. The secondary objective of the APR is to control the pressure regulator (or turbine bypass valve position) during reactor heatup and depressurization. The APR contains the algorithms for the control functions that it performs. It is typically in the automatic mode but if something is abnormal then the PGCS will be placed in the manual mode along with the APR. The operator then can perform the functions that the PGCS and APR typically perform.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. RCW shall meet heat removal requirements for normal and emergency operation.
2. TCW shall meet its heat removal requirements.
3. RSW shall meet requirements for heat removal from RCW.
4. TSW shall meet requirements for heat removal from TCW.

b. Assure these precautions are identified and met during the test:

1. Operation within the power flow map.
2. Integrity of systems being tested is maintained.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level and status.
2. Required pre-operational tests are completed.
3. Test specifies required operable equipment per TS.
4. Setup of calibrated test equipment to record data.
5. Required RPS trips are functional.
6. Required hydrostatic tests have been completed for systems being tested.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Verification of heat removal capabilities of RCW, TCW, RSW, and TSW.
2. Monitoring of critical parameters as required to confirm d.1.
3. Verification of final flow balancing for systems being tested.
4. Extrapolation of results for limiting or accident conditions.

General Guidance:

The verification of the heat removal capability of each cooling system will be dependent on whether the flow rates and temperature differentials evident on each of their process flow diagrams is achieved. The temperatures and flow rates will either be indicated on MCR control panels or at local indication for the various components cooled. Using the licensee’s approved calculation method, an inspector could perform rough calculations to check whether each of the systems is actually performing as intended. The licensee’s test procedure should have places to record the expected and as-found temperatures and flow rates for the cooling systems and the associated components. The licensee should have documentation of how the test results for these systems can be extrapolated to demonstrate their required performance under worst case conditions for either accident or event conditions. The RCW and RSW systems have safety-related functions and the cooling demands on them are heaviest during either normal or emergency shutdown and post-LOCA conditions. The primary safety-related components cooled by these systems are the RHR heat exchangers and motors for the pumps of various ECCS systems.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. RCIC turbine shall not trip during starts.
2. RCIC pumps average discharge is equal or greater than rated for all modes.
3. RCIC shall meet operating time line per system design specification.
4. RCIC flow responses shall be per system design specification.
5. RCIC Turbine Gland Seal System minimizes steam leakage.
6. For automatic starts, margins to turbine overspeed and RCIC isolation trip shall meet test specification.
7. High flow trip for RCIC Turbine steam supply actuates per TS.

b. Assure these precautions are identified and met during the test:

1. Operations has approved initiation of test.
2. Operation with in power flow map.
3. Single failure of RCIC does not compromise safe operation of plant because of the unavailability of other critical systems.

c. Confirm these initial conditions are identified and met during the test:

1. Status of Rx and power level.
2. Required plant equipment operational per TS.
3. Instrumentation available to monitor parameters for test.
4. Appropriate operations and engineering personnel.
5. Proper alignment of RCIC.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Demonstration of general system operability by manual and automatic starts including steady state operation with full flow operation into the suppression pool. Throttling of pump discharge to simulate reactor pressure and expected system pressure drops.
2. Adjustment of RCIC turbine speed control loop by injection into Rx vessel to demonstrate a system start from hot standby conditions. Small step disturbances to check correct adjustment of the control loop.
3. Demonstration of automatic start from cold standby for Rx vessel injection. Full flow operation to provide benchmark for future operation.
4. Adjustment of RCIC steamline flow trip and recording operational data.
5. Any tests not conducted during pre-operational testing.

General Guidance:

RCIC automatically initiates for a Rx water Level 2 or high drywell pressure. RCIC operates before the Rx vessel is depressurized to allow the shutdown cooling mode of RHR to begin. RCIC shall meet the time line in the TS for reaching maximum flow after an automatic start. The turbine governor and steam control valve should be properly adjusted per the vendor manual. The turbine controls and associated valves shall be carefully adjusted to prevent high exhaust pressure and overspeed of the RCIC turbine. The minimum flow bypass should be operational at low system flow and high pump discharge pressure.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1 Temperature of tube side outlet of CUW non-regenerative heat exchanger per design.
2. TDH of CUW pump per design.
3. The heat exchange capacity of each CUW non-regenerative heat exchanger per design.
4. CUW pump and motor vibration shall meet applicable standard.
5. Cooling water flow to CUW non-regenerative heat exchanger per design.

b. Assure these precautions are identified and met during the test:

1. Integrity of CUW is maintained.
2. Operation within power flow map.

c. Confirm these initial conditions are identified and met during the test:

1. Status of Rx and power level.
2. Required plant equipment operational per TS.
3. Instrumentation available to monitor parameters for test.
4. Pre-operational testing is completed.
5. Proper alignment of CUW.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Operation of CUW demonstrated for the following modes of operation:
   a.) Normal
   b.) Blowdown Mode
   c.) RPV Spray Mode
   d.) Hot Standby Mode
2. Monitoring of critical parameters for all modes of operation.

General Guidance:

CUW is a close looped system except under certain conditions. The reactor coolant is cooled by the RHX and NRHX before it is processed by the F/D units. The outlet temperature of the NRHX is critical so it is monitored. A high-high temperature isolates the F/D units, causes F/D units to be bypassed, and annunciates an alarm in the MCR. CUW takes suction from the RHR ‘B’ shutdown suction line and the RPV bottom head drain. The Rx vessel water level will remain at 15 inches above top of active fuel even if CUW’s shutoff valve fails to close for a leak in CUW. Blowdown mode of the CUW is to remove excess Rx water level during S/U, S/D, and hot standby. Rx vessel spray mode is for rapid cooldown of the Rx vessel. During hot standby, CUW maintains temperature gradients in bottom head of Rx vessel by maintaining circulation. The primary safety concerns for CUW are the integrity of its piping upstream of CUW’s isolation valves and the removal of radioactive fission products and other impurities in reactor coolant. This test or another test should check for automatic isolation of CUW for initiation of SLCS. The rated capacity of CUW is about 2% of rated FW flow.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

   1. RHR should function in the suppression pool and shutdown cooling modes with flow rates and temperatures in accordance with the system design specification.

b. Assure these precautions are identified and met during the test:

   1. Rx vessel cooldown rate is not exceeded.
   2. Operation of plant within power flow map.
   3. Integrity of the RHR is maintained.

c. Confirm these initial conditions are identified and met during the test:

   1. Rx power level and status.
   2. Plant status as required by TS.
   3. RCS temperatures and pressures.
   4. RPS related trips are functional.
   5. Instrumentation available to monitor parameters for test.
   6. Pre-operational testing is completed.
   7. RHR meets initial conditions for manual or automatic initiation of shutdown or suppression pool cooling modes.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

   1. RHR aligned for suppression pool cooling.
      a.) Monitoring of temperatures for RHR heat exchangers.
      b.) Verifying flow rates of RHR pumps.
      c.) Checking that all RHR valves are properly positioned.
      d.) Checking the opening and closing times of all RHR valves.
      e.) Monitoring key parameters.
      f.) Comparing expected design values with actual values measured for key parameters.
      g.) Determining if the RHR meets expected time line, if any, for cooling the suppression pool.
   2. RHR aligned for shutdown cooling.
      a.) The same checks and verifications of temperatures, flow rates, position of RHR valves, key system parameters, system time lines, etc. as when aligned for suppression pool cooling.

General Guidance:

RHR provides core cooling, suppression pool cooling, wetwell and drywell sprays, and shutdown cooling. The inspector should understand the arrangement of RHR for each of these modes of operation. The alignment of valves, time line for operation, integrity of system, operation of pumps and heat exchangers for each mode should be understood so that it is possible to assess the operation of this system for those modes. This system is a multi-functional system with several safety functions so its proper operation is key to the safe operation of the plant, especially during emergency shutdown due to accidents or events.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Operators can shutdown the Rx from normal power and maintain hot standby.
2. Operators bring Rx to a point approaching cold shutdown conditions where RHR shutdown cooling is initiated. These types of operations are available to the operators from the outside the Main Control Room.

b. Assure these precautions are identified and met during the test:

1. Sufficient operators are available in case of an emergency.
2. Prescribed cooldown limits are not exceeded.
3. Shutdown margin is maintained.

c. Confirm these initial conditions are identified and met during the test:

1. Operators using required normal and emergency operating procedures.
2. Communication requirements.
3. Rx power level and status and basis.
4. Shutdown margin is maintained.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Evacuation of the MCR. Transfer control of plant from MCR to means outside of MCR.
2. After transferring control, operators will trip and isolate the Rx per plant procedures.
3. Operators taking plant to hot standby per procedures.
4. Demonstration of capability to take plant to cold shutdown either in this test or another startup test.

General Guidance:

RSS provides instrumentation and controls on two divisional panels located in the Rx building. Prior to evacuating the MCR, the operators will scram the Rx. No other event is assumed to occur with the event necessitating MCR evacuation. RSS controls 1 or 2 divisions in the following systems: RHR, HPCF, NBS, RCW, RSW, Electrical Systems, and Flammability Control System. After tripping Rx, pressure is controlled by NBS relief valves with HPCF controlling Rx water level. RHR is used to cool the suppression pool at this time. Once Rx pressure is low enough, then HPCF will cease operation. RHR will then operate in the shutdown cooling mode to bring the Rx down to hot standby and cold shutdown. Hot standby is typically where Rx water temperature is about 350 to 200 degrees Fahrenheit with cold shutdown being where Rx water temperature is less than 200 degrees Fahrenheit. The RCW system is used to primarily cool the RHR heat exchangers and RSW is used to cool the RCW system. The instrumentation and controls on the RSS panels are activited by overriding MCR controls and transferring control functions to the RSS panels. The inspector can see all these systems in operation at the RSS panels as the plant proceeds to cold shutdown. The test procedure should have the time line for the operation of systems and of obtaining hot standby and cold shutdown.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Steam jet air ejectors maintain main condenser pressure per design.
2. CW cools steam in main condenser per design.
3. The FW system heats up per design.
4. Water level in LP/HP heaters and heater drain tanks is per design.
5. Moisture separator supplies steam to LP turbine and FW heaters per design.
6. Main condenser maintains LP turbine exhaust parameters per design.
7. Main condenser hotwell water level is per design.
8. T/G shall operate with a heat rate compatible with design value.

b. Assure these precautions are identified and met during the test:

1. Integrity of steam and power conversion system is maintained.
2. Operation within the power flow diagram.

c. Confirm these initial conditions are identified and met during the test:

1. Status of RCS temperature and pressure.
2. Instrumentation to measure test parameters.
3. Rx status and power level.
4. Plant configuration per TS.
5. Pre-operational tests are complete.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Plant at full power with test parameters being monitored. The test parameters being monitored are those required to complete the acceptance criteria:
   a.) Main condenser pressure, temperature, and water level.
   b.) FW temperature at various points
   c.) Water level in FW heaters and heater drain tanks.
   d.) Steam flow to LP turbine and FW heaters.
   e.) LP turbine exhaust pressure and temperature.
   f.) Steam flow to T/G and T/G's pressure, temperature, and speed.

General Guidance:

This test is reviewing the operation of systems required for steam entering the condenser and back to the Rx after being condensed and transported back the Rx through the condensate and FW systems. These systems have no safety functions and are for power generation. The inspector can check the operation of most of these parameters on MCR indication and can assess some of the following as representative of the performance of the startup test program in general:
- Steam flow to the steam air ejectors and offgas flow from them.
- CW flow to the main condenser, condenser vacuum and hotwell level.
- Temperature of FW after each stage of low and high pressure heaters.
- Steam flow and water level for LP/HP heaters and heater drain tanks.
- Steam flow from moisture separator to LP turbine and FW heaters per design.
- LP turbine exhaust steam flow and temperature.
- Condensate and FW flow at the discharge of the condensate and FW pumps.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Steam exiting separators/dryers has moisture to steam percentage per design.
2. Determination of power level where moisture carryover not per design.
3. Speed runback logic set to not permit operation with excessive moisture carryover.

b. Assure these precautions are identified and met during the test:

1. Operation in the allowable region of power flow map.
2. Excessive moisture carryover is not allowed.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing is completed.
2. Equipment required for the test are operable.
3. The required control room and auxiliary operators are on duty.
4. The required systems per TS are operable.
5. Runback logic is correctly calibrated.
6. Rx power level and status.
7. Region of power flow map in which plant is operating.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Checking moisture carryover in the steam exiting the Rx at various power levels.
2. Continuing test until either separator limit line on power flow map is reached or excessive moisture carryover is determined.
3. Record point at which RIP speed runback logic is initiated.

General Guidance:

The steam separators and steam dryers are non-safety components that remove and dry the steam exiting the reactor vessel. The power flow map has four regions: Regions I, II, III, and IV. Operation is permitted only in two regions: RI and RIV. Operation in Region II is not permitted and it is separated from Region IV by the steam separator limit line. Crossing over the steam separator line and operating in Region II is precluded by system interlocks. If the moisture content in the steam exiting the separators is too high then a recirculation runback occurs to decrease the steaming rate of the Rx. The inspector would be able to see that runback as evidenced by decreased speed of RIPs and decreased steam flow out of the reactor plus decrease in Rx power level and turbine output. Typically, the nuclear system equipment, nuclear instrumentation, and RPS, along with operating procedures, maintain operations within the area of power flow map for normal operating conditions. Preventing excessive moisture from entering the turbine is primarily a power generation concern but a turbine malfunction could precipitate a Rx scram.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Turbine bypass valves open in specified time per design.
2. FWCS prevents flooding of main steamline.
3. The core flow coastdown transient per plant transient/stability requirements.
4. Changes in vessel dome pressure and fuel surface heat flux per Transient Safety Analysis Design Report.
5. MSIVs will not close during first three minutes.
6. Rx will not trip if initially at low power level.
7. High Rx water trip should not occur due to FW control system.
8. Temperature of SRV's discharge returns to near normal after event.
9. Response time of SRVs per design specfication.
10. RIP trips and HPCF/RCIC initiation does not occur.

b. Assure these precautions are identified and met during the test:

1. The turbine overspeed does not affect voltage and frequency sensors.
2. Operation within the power flow map acceptable range.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power levels and status for various test conditions.
2. Rx and turbine control and protection circuits are available.
3. Incore instrumentation available.
4. Turbine bypass system and safety relief valves are functional.
5. Required pre-operational testing is complete.
6. Systems required per TS are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them: The turbine should continue to supply in- house loads with no Rx trip. The steam dump system should remove heat from the RCS with the Rapid Power Reduction System reducing power if necessary.

1. Load rejection at rated power level.
2. Monitoring key plant parameters appropriate for meeting above acceptance criteria including overspeed of turbine.
3. Load rejection or turbine trip at low power level to verify that Rx does not scram.

General Guidance:

For the load rejection, there should be a runback in power but the Rx will not scram if the power is less than 40%. The turbine bypass system will be able to dump the excess steam, from 12 to 22 % of rated steam load, to the condenser since the Rx will be at a low power level. A turbine trip initiates closure of main stop valves and turbine bypass operation. The closure of stop valves typically initiates reactor scram and trip of four RIPs but not for power levels less than 40%. The FW, condensate, and circulating water pumps will not be lost. Water level in the Rx vessel may initially decrease but the FW pumps should be able to maintain Rx water level. The Rx will not scram and will be operating at a lower power level until the problem with the turbine is discovered and corrected allowing the T/G to be restarted. The in-house loads will be powered from offsite power sources.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

   1. Rx will not scram or isolate for full closure of turbine valves (control, stop, and bypass) up to power level specified in surveillance procedures.
   2. For full closure of any of the turbine valves, scram avoidance margins should be maintained for critical plant parameters.
   3. Total bypass valve capacity meets nuclear safety operational analysis.

b. Assure these precautions are identified and met during the test:

   1. Turbine should not trip and Rx should not scram.
   2. Operation within the allowable region of the power flow map.

c. Confirm these initial conditions are identified and met during the test:

   1. Status of reactor and power level.
   2. Pre-operational testing complete.
   3. Required systems to be operable per TS.
   4. Turbine valves are functionable.
   5. Instrumentation in place to monitor key parameters.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

   1. Demonstration of operability of turbine valves similar to TS surveillance program.
   2. Determination of maximum power level at which these tests can be done.
   3. Monitoring of key plant parameters and plant's response during testing of the turbine valves.
   4. Determination of maximum capacity of turbine bypass valves with adjustment of Rx power level and turbine loading as required.

   General Guidance:

   The protection logic allows for the test closing of main turbine control, stop, and bypass valves individually and the Rx is not supposed to scram during their testing. This test merely confirms those testing capabilities of the turbine valves and also determines the maximum power level at which testing can be performed during routine operations. For the closing of a turbine valve, the Rx pressure will increase a little but will settle out since the logic circuitry will open the other turbine valves more. The turbine bypass system is typically operational when the turbine is not available or for the failure of one turbine stop or control valve. This test confirms that the turbine bypass system can handle the rated steam load per its design specification which is around 12 to 22% of total plant rated steam load. The inspector can witness the closing of each turbine valve within the time required, in the accident analysis, the maximum power level at which this can be safely achieved, and the total load capability of the turbine bypass system which also is considered in some Chapter 15 accident analyses. In addition, the inspector will witness that the protection logic will not activate until the testing of turbine valves is done at a higher power level.

Attachment 22

ABWR STARTUP TESTS

CLASS I: MANDATORY ABWR S/U TESTS FOR INSPECTION

References are to sections in Regulatory Guide 1.68, Revision 2, Appendix A.

Group A	Group B	Test Title	Ref.
	X	Control Rod Drive System Performance (14.2.12.2.5)	4.b.
X	X	Core Performance (14.2.12.2.8)	5.b.
	X	Feedwater Control (14.2.12.2.14)	5.s.
X		Feedwater Pump Trip (14.2.12.2.29)	5.v.
	X	Feedwater System Performance (14.2.12.2.18)	5.v.
X	X	Fuel Loading (14.2.12.2.3)	2
X	X	Full Core Shutdown Margin Demonstration (Initial Criticality (14.2.12.2.4))	3
	X	Loss of Turbine/Generator and Offsite Power (14.2.12.2.32)	5.j.j.
X		Main Steam System Performance (14.2.12.2.19)	5.v.
	X	MSIV Performance (14.2.12.2.26)	5.u.
X		Neutron Monitoring System Performance (14.2.12.2.6)	4.d.
X		Plant Automation and Control (14.2.12.2.16)	4.n.
	X	Plant Cooling/Service Water System(s) Performance (14.2.12.2.23)	5.x.
	X	RCIC System Performance (14.2.12.2.22)	5.l.
X		Reactor Water Cleanup System Performance (14.2.12.2.23)	4.r.
X		Residual Heat Removal System Performance (14.2.12.2.20)	5.l.
X		Shutdown From Outside the Main Control Room (14.2.12.2.31)	5.d.d.
	X	Steam and Power Conversion System Performance (14.2.12.2.39)	5.v.
	X	Steam Separator/Dryer Performance Test (14.2.12.2.40)	5.v.
X		Turbine Trip and Load Rejection (14.2.12.3.33)	5ll,5n
X		Turbine Valve Performance (14.2.12.2.25)	5.t.

CLASS II: RECOMMENDED ABWR S/U TESTS FOR INSPECTION	
DCD Test No	**Test Title**
14.2.12.2.1	Chemical and Radiochemical Measurements
14.2.12.2.35	Gaseous Radwaste Management/Offgas System
14.2.12.2.24	HVAC System Performance
14.2.12.2.9	Nuclear Boiler Process Monitoring
14.2.12.2.15	Pressure Control
14.2.12.2.7	Process Computer System Operation
14.2.12.2.2	Radiation Measurements
14.2.12.2.34	Reactor Full Isolation
14.2.12.2.12	Reactor Internals Vibration
14.2.12.2.17	Reactor Recirculation System Performance
14.2.12.2.27	SRV Performance
14.2.12.2.10	System Expansion
14.2.12.2.11	System Vibration

Attachment 23

Revision History For IP 72303

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	09/05/06 CN 06-021	IP 72303 has been issued for Construction Inspection Program	None	N/A	ML061100395